training and workload is carefully considered to mitigate risks to patients.
1. Huang G et al. Error in the delivery of radiation therapy: Results of a quality assurance review. Int J Radiat Oncol Biol Phys 2005;61:1590–1595.
2. Kapur A et al. Incident Learning and Failure-Mode-and-Effects-Analysis Guided Safety Initiatives in Radiation Medicine. Front Oncol. 2013 3:305.
3. Kalapurakal JA et al. A comprehensive quality assurance program for personnel and procedures in radiation oncology: value of voluntary error reporting and checklists. Int J Radiat Oncol Biol Phys. 2013 86(2):241-8.
4. Hunt MA et al. The impact of new technologies on radiation oncology events and trends in the past decade: an institutional experience. Int J Radiat Oncol Biol Phys. 2012 84(4):925-31.

OC-0395

Patient selection in head and neck adaptive radiotherapy

C. Brouwer[1], R. Steenbakkers[1], A. Van der Schaaf[1], C. Sopacua[1], L. Van Dijk[1], R. Kierkels[1], H. Bijl[1], J. Burgerhof[1], J. Langendijk[1], N. Sijtsema[1]
[1]*University of Groningen- University Medical Center Groningen, Department of Radiation Oncology, Groningen, The Netherlands*

Purpose or Objective: During the course of head and neck radiotherapy, anatomical changes may lead to underdosage or hotspots in target volumes, and overdosage in organs at risk (OARs). The largest dose differences between planned and actual given OAR dose have been reported for the parotid glands (PGs). Dose increase to the PGs could lead to an increase of radiation induced side effects, justifying adaptive radiotherapy (ART) to reduce the PG dose. Still, ART procedures are labour intensive and only a fraction of patients will benefit. The aim of this study was to develop and validate a method to predict dose deviations from the planned PG mean dose, to select patients for adaptive radiotherapy (ART) up-front.

Material and Methods: Planning and response (6 weeks after RT) CT-scans from 113 head and neck cancer patients (cohort A) were used to estimate deviations between planned and actually given PG mean dose (ΔDmean). Potential pre-treatment selection parameters presented in recent literature were included in the analysis. Uni- and multivariable linear regression analysis for the endpoint PG ΔDmean was performed to select pre-treatment parameters eligible for patient selection. ROC curve analysis was performed to determine cut off values for selecting patients with PG ΔDmean larger than 3 Gy with a sensitivity in the range of 70-100%. The proposed method of patient selection was validated in another patient cohort consisting of 43 head and neck cancer patients who received weekly rescan CTs (cohort B).

Results: In univariable analysis, pre-treatment parameters significantly associated with PG ΔDmean were: BMI, chemotherapy, T-stage, N-stage, volume of the GTV, tumour location, overlap of the PG with the high and low dose PTV, V20, V30, V40 and mean dose of the PG. In multivariable analysis, the initial PG mean dose remained the only significant parameter. ROC results were summarized in Table 1. Selection of patients for dose deviations larger than 3 Gy with a sensitivity of 90% could be obtained by a threshold of the initial PG mean dose of 22.2 Gy (Table 1). This would select 62% of patients for ART in cohort A and 76% in cohort B with a corresponding precision of 29 and 19%, saving 38 and 24% of patients from the labour-intensive ART procedure.

Conclusion: We succeeded to develop a method to select patients for ART up-front by using the initial mean dose to the parotid gland. The labour of ART could be reduced by 24-38% with 87-90% sensitivity, contributing to a more effective allocation of the department resources.

Table 1. Performance of the classification of patients for a parotid gland dose deviation > 3 Gy by using the initial mean dose of the parotid glands (PG D_{mean})

Cut off value PG D_{mean} (Gy)	0	3.6	22.2	24.7	27.0
Cohort A					
Sensitivity (%)	100	100	90	80	70
Specificity (%)	0	33	45	50	60
% selected for ART	100	74	62	56	46
Precision (%)	20	27	29	29	30
Cohort B					
Sensitivity (%)	100	100	87	60	40
Specificity (%)	0	0	19	38	46
% selected for ART	100	100	76	62	51
Precision (%)	18	18	19	17	14

Precision = true positives / (true positives + false positives)

Symposium with Proffered Papers: Time is not on our side: cardiovascular toxicity after radiotherapy

SP-0396

The risk of cardiovascular disease after breast cancer treatment: the clinician's point of view

C. Taylor[1]
[1]*University of Oxford, Clinical Trial Service Unit, Oxford, United Kingdom*

Background: Breast cancer radiotherapy reduces the risk of cancer recurrence and death. However it usually involves some radiation exposure of the heart which may increase the risk of subsequent heart disease. Epidemiological data suggest that the major coronary event rate increases by 7.4% per Gy mean heart dose[1]. Estimates of the absolute risks of radiation-related heart disease are needed to help oncologists plan each individual woman's treatment. The absolute risk for an individual woman depends on her estimated cardiac radiation dose and her background risk of ischaemic heart disease in the absence of radiotherapy. When the risk is known, it can then be compared with the absolute benefit of the radiotherapy.

Methods: Worldwide data on heart doses in breast cancer radiotherapy published during 2003-2013 were collated systematically. Analyses considered the variation in the typical mean heart dose according to various patient and treatment-related factors including laterality, target(s) irradiated and technique[2]. These heart doses were used to predict typical absolute cardiac risks from breast cancer radiotherapy using the dose-response relationship of a 7.4% per Gy increase in the rate of major coronary events.[1] These risks were compared with estimates of the absolute benefits of breast cancer radiotherapy.

Results: In left breast cancer, mean heart dose averaged over 398 regimens in 149 studies from 28 countries was 5.4 Gy (range <0.1-28.6 Gy). In left-sided regimens that did not include the internal mammary chain, the average mean heart dose was 5.6 Gy (range <0.1-23.0) for inverse-planned intensity modulated radiation therapy, 3.4 Gy (range <0.1-12.4) for tangential irradiation, 2.2 Gy (range <0.1-3.8) for brachytherapy and 0.5 Gy (range 0.1-0.8) for proton beam therapy. On average, inclusion of the left IMC doubled the heart dose. In 93 regimens where the left IMC was irradiated, average mean heart dose was around 8 Gy for most photon or electron techniques, and it varied little according to which other targets were irradiated. In right-sided breast cancer, the average mean heart dose was 3.3 Gy based on 45